R5: Pathfinding Lean Development and Accelerating Payloads to Orbit

2023 Small Satellite Conference

August 2023
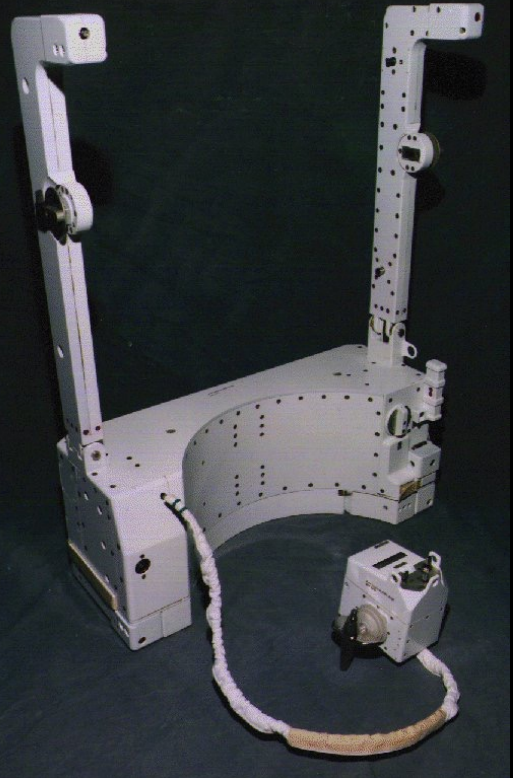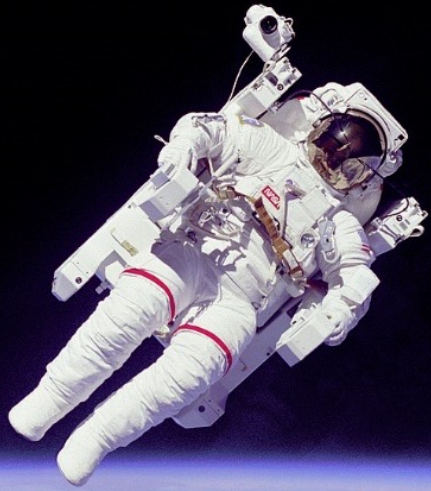
Sam Pedrotty, R5 Project Manager

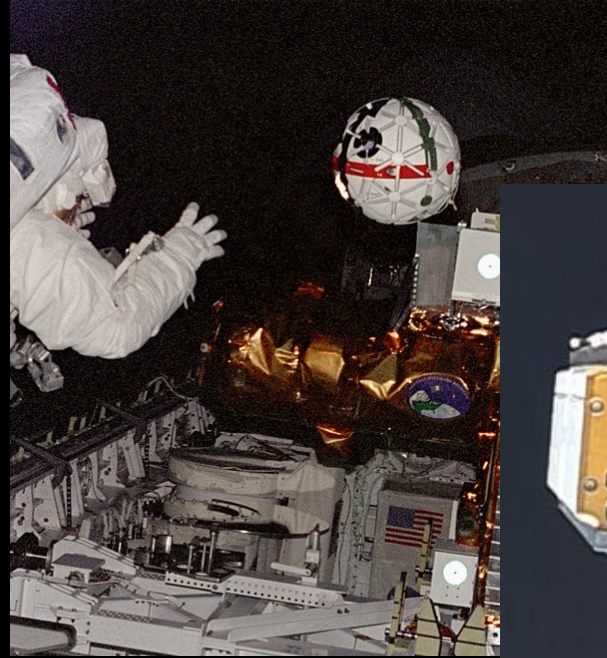# *You May Remember Us From Such Spacecraft As...*

Manned Maneuvering Unit

Simplified Aid For EVA Rescue

AERCam Sprint

Seeker

Image of Cygnus captured by Seeker

Mini AERCam

R5: Reassessing Cost and Speed

- STMD-funded, intended to provide **rapid, low-cost, high-risk method to get TRL 4 payloads to TRL 8**
  - Evaluating **ultra-lean, COTS-based approach**es to define new thresholds for cost and schedule
  - Hosting **payload/technology demonstrations** onboard each spacecraft

- (Once we get data) we intend to **broadly share experience and lessons learned** to accelerate/enable the small spacecraft community

- Status: 1 spacecraft launched, 2 set for delivery, 2 approaching fabrication, more in planning


Spacecraft 2

Spacecraft 4
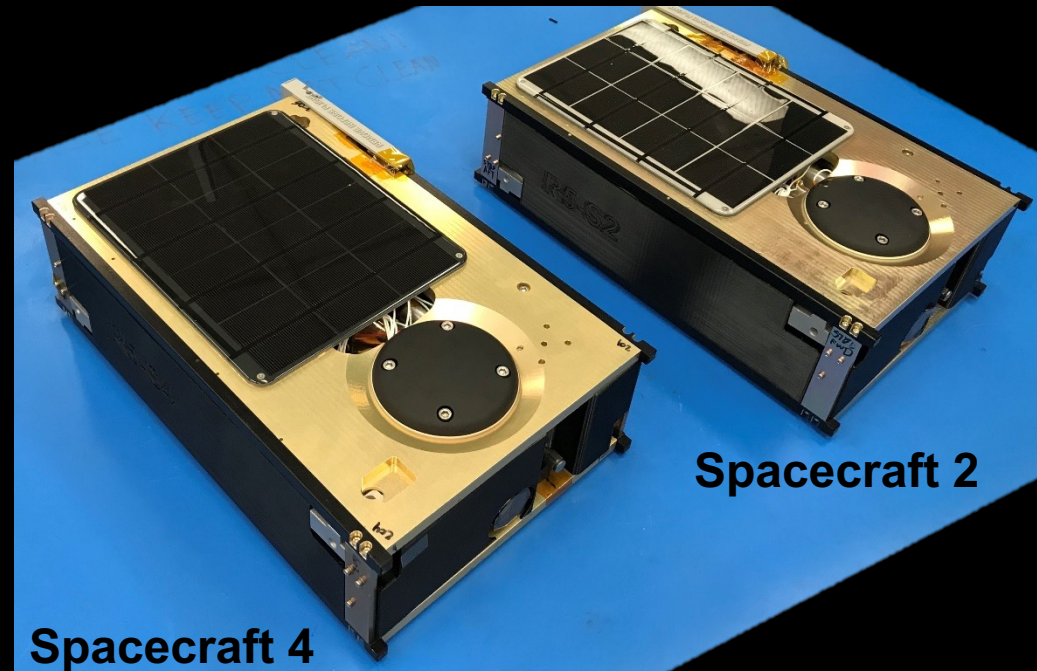
R5 Baseline

- Bus baseline:
  - Form factor: 6U (2x3U)
  - Energy: 70+ W*hr
  - Prop: 6DOF cold-gas
  - Comm: Iridium beacon, COTS-based SDR
  - Compute: "High performance" COTS
  - GNC: Full inertial, basic relative
    - Star tracker, IMU, reaction wheels, vision-based bearing
- Operations baseline
  - Ops autonomously executed onboard
    - Limited ground control possible
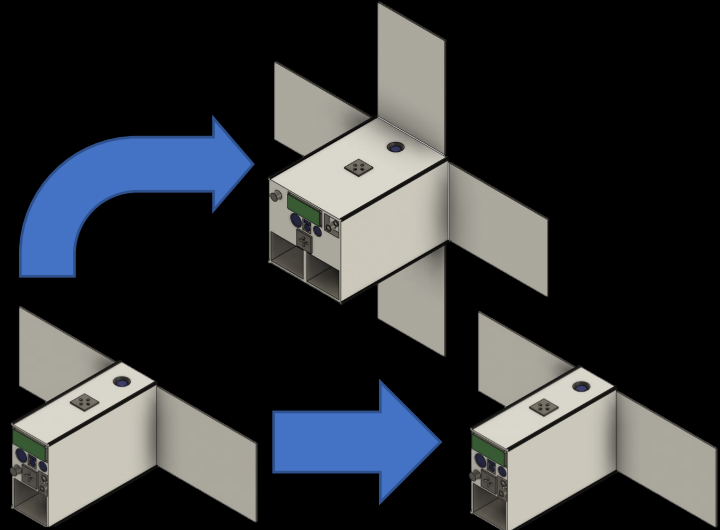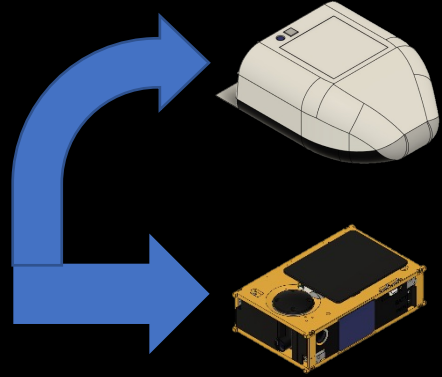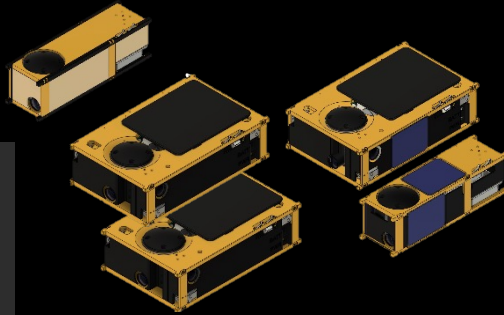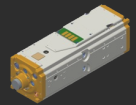 - Resulting data autonomously and asynchronously downlinked
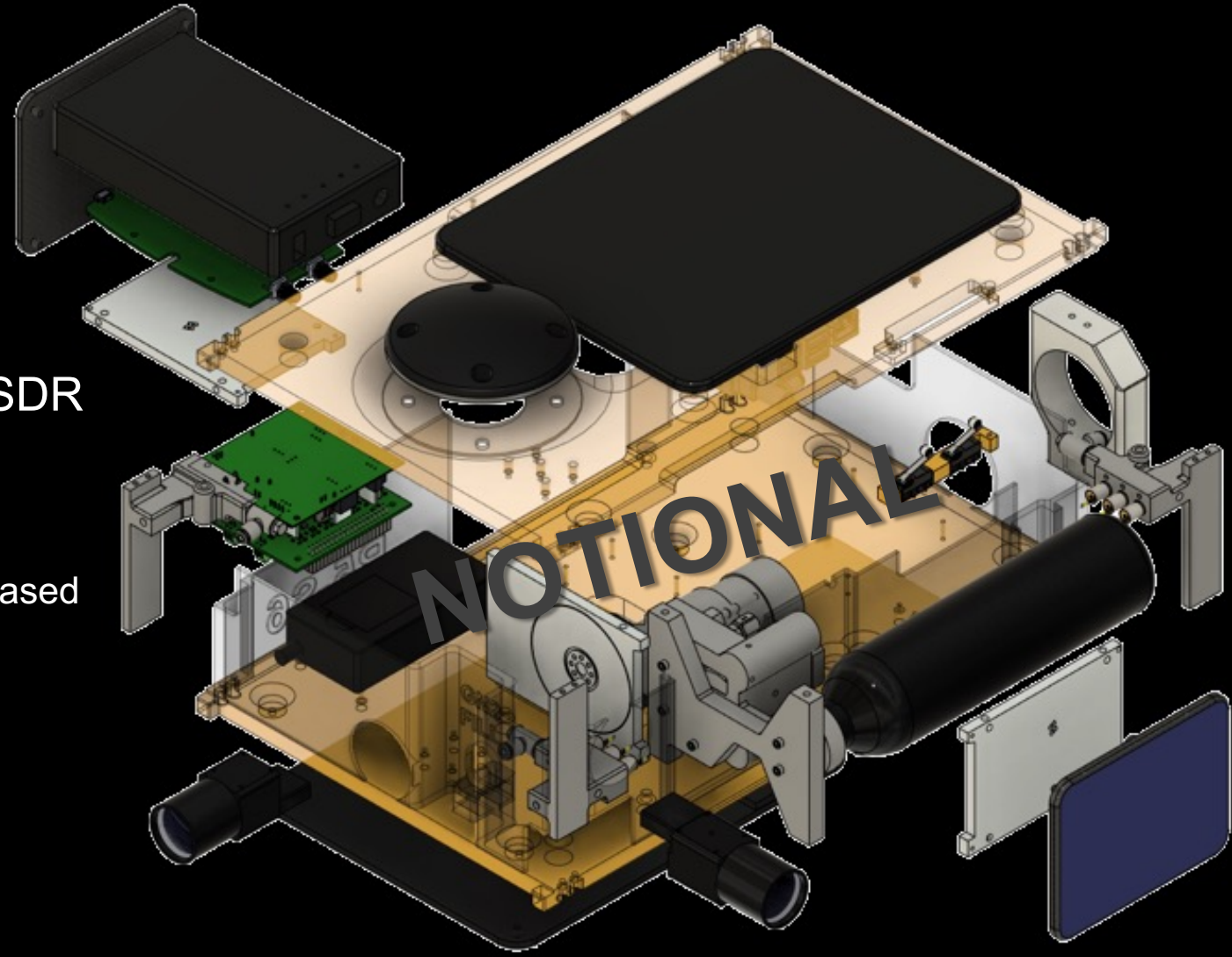
NOTIONAL

R5 [Notional] Evolutionary Path

Reentry Vehicle [Notional]
Core avionics and new process enables subscale suborbital demonstration of reentry platform

Rendezvous Inspector [Notional]
Enable inspection of any client

Seeker 1
Demonstrated form factor and process feasibility

R5 (VCLS-2 Flights)
- Demonstrate new process
- Demonstrate core avionics
- Demonstrate responsive call-up
- Demonstrate first user payloads

R5 (Operational Target)
Execute multiple payload demonstration flights, advancing human spaceflight and SST technologies

Seeker 2 [Notional]
- Provides critical in-space inspection capability for crewed and uncrewed vehicles
- Far faster and cheaper after prior efforts

Seeker 3 [Notional]
Evolve inspector to servicer

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Thanks!

- We hope to have data for you by Small Sat 2024
  - In the meantime, feel free to peruse Seeker:
    - https://ntrs.nasa.gov/search?q=seeker&published=%7B%22gte%22:%222017-01-01%22%7D
    - https://software.nasa.gov/software/MSC-27108-1
  - … and our star tracker software suite: https://github.com/nasa/COTS-Star-Tracker

- We're interested in collaboration, especially with:
  - "Easy-to-license" RF comm
  - Optical comm
  - Proximity operations

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